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## ***Envelope: Residential Fenestration***

### Description

Issues that will be studied for inclusion in the 2005 *Standards* are;

- Create package alternatives for prescriptive compliance with higher fenestration percentages, since the current restriction on fenestration percentage sometimes prevents the packages from being used. The energy impacts of increased glazing percentage may be -offset by increasing the performance of the fenestration products or - making other building features more efficient. Special treatment for west-facing glass in cooling zones will be considered due to the large impact on peak cooling loads.
- For performance calculations, Make the glazing area of the reference house in performance calculations the same as the glazing area of the proposed house up to some reasonable high value, such as 20% of conditioned floor area. Dwellings with larger glazing areas will be able to trade off the fenestration area against other features.
- Improve fenestration performance by specifying lower U-factors in the prescriptive packages. The interaction between SHGC and U-factors needs to be considered when determining the standard SHGC and U-factor values achieved by the same product type.

### Benefits

The initiatives are designed to make the prescriptive and performance approaches more neutral to fenestration area with a goal of making the standards more usable for buildings with typical fenestration areas, and to make sure that dwellings with smaller glazing areas still use energy efficient fenestration products that are cost effective. The prescriptive standards will apply to a wider range of homes, making them more useful to the building industry. The impact on homes with larger fenestration areas is not clear at this time, but could lead to decreased electricity demand and energy savings. Reducing the importance of glazing area will also simplify compliance calculations and make it easier to verify compliance in the field.

By including lower U-factor products that are cost effective in the standards, energy savings and product demand will increase, and indoor comfort will improve.

No impacts are anticipated on maintenance costs, indoor air quality benefits, health and safety benefits, productivity, or increased property value. Time-dependent valuation is not expected to significantly affect the benefits derived from these changes.

### Environmental Impact

To the extent that changes could increase the amount of fenestration in California, significant environmental impacts could occur. No other significant adverse environmental impacts are anticipated from these changes.

### Type of Change

Changes to how fenestration is treated will likely have a significant impact on all Standards-related documents including the *Standards* themselves, the ACM Manual, the Residential Manual and the compliance forms. In the *Standards*, changes to the prescriptive approach would need to be documented. In the ACM Manual, revised rules and modeling tests would need to be developed. The Residential Manual and compliance forms would need to be revised to match requirements.

### Measure Availability and Cost

Changes to fenestration performance have been a significant topic in prior proceedings. Recent studies have shown that the market penetration of vinyl frames, the most likely frame material upgrade in new construction, is now more than half the market and widely available from many different manufacturers. A new cost estimate for this upgrade will need to be established, but is likely to be less than \$1/ft<sup>2</sup> of fenestration area. However, for

many builders, use of vinyl windows has become standard for more than just energy reasons. For them, the upgrade cost is zero. Low income housing cost impacts, especially those related to multifamily buildings, will be examined.

### Useful Life, Persistence and Maintenance

For the treatment of fenestration area in both the prescriptive and performance approaches, no impacts on the life, persistence or maintenance are anticipated. For lower U-factor products, there may be issues related to the use of some types of low conductance frames, in terms of the life of the measure, which may need to be considered in the life-cycle costing calculations.

### Performance Verification

The proposed changes described in this document do not modify the verification process significantly.

### Cost Effectiveness

Changing the rules for the treatment of fenestration area may have cost impacts on dwellings that are typically constructed with glass areas different from the fixed glass areas in the current packages. Eliminating glazing area as a major compliance variable will possibly lead to more builders using cost effective measures.

During the last standards proceeding, low-conductance frames were shown to be cost effective under a wide range of assumptions, as is expected to be true for this proceeding as well.

### Analysis Tools

The treatment of fenestration measures in computer performance calculations affects all aspects of the standards development process. The best approach would be to incorporate proposed fenestration changes into the computer performance method early in the process, so that the revised calculations can be used to establish the prescriptive packages based on their cost effectiveness.

### Relationship to Other Measures

Glazing area changes alter the heating and cooling loads of residences, and therefore have a modest secondary effect on the cost effectiveness of most other measures.

Other issues related to the impact of this change also need to be considered, including the effect on buildings with different orientations, subdivision compliance using multiple orientations, and how this modeling change will impact development of the prescriptive packages. Estimating the overall impact of this change will require knowledge of the distribution of fenestration areas in California dwellings. Implementing this concept would also change a long-standing feature of computer performance compliance that there is one standard energy use for a building geometry and size in each climate zone.

### Bibliography and Other Research

It may be useful to study how other building energy codes treat fenestration. One limitation of many older codes, such as those from Oregon and Washington, is that they do not effectively deal with cooling-related performance, and few except Florida's rely on performance calculations as the basis. Even older versions of the *Model Energy Code*, such as the 1993 version that is the basis of the Energy Star home program, do not address cooling related topics effectively. With growing acceptance in other states, the *2000 International Energy Conservation Code* has both a 0.40 SHGC requirement in most cooling climates and prescriptive packages that allow for more fenestration area than the California standards.

Regional Economic Research, Inc. (RER) has completed recent studies that may be useful. One study, *Residential New Construction Study* (September 2001) for Pacific Gas and Electric Company, uses on-site surveys of approximately 800 recently constructed California homes to establish typical energy efficiency characteristics, including fenestration percentages and fenestration product performance. Another RER study that may be useful is the *Low-rise Multifamily Building New Construction Characteristic Study* (July 2000) for

the California Energy Commission. This study examined computer performance compliance documentation and describes typical multifamily energy efficiency characteristics, including fenestration percentage.

Additional information on recent builder practices related to fenestration can be found in the 1999 and 2000 final reports for the Builder Energy Code Training project completed by the Building Industry Institute with funding from the California Energy Commission.

Data on the types of fenestration products produced is available from the *2000 AAMA/WDMA Industry Statistical Review and Forecast*, published jointly by the American Architectural Manufacturers Association and the Window and Door Manufacturers Association.

To support an expected proposal by DOE to eliminate glazing area as a residential compliance variable in the *International Energy Conservation Code*, Pacific North West National Laboratory has prepared a white paper discussing the possibility of eliminating window-wall ratio (WWR) based requirements from residential energy codes. The proposal can be accessed at: [http://www.energycodes.org/DOE\\_2003\\_Proposals.html](http://www.energycodes.org/DOE_2003_Proposals.html).